

WHAT IS CLAIMED IS:

- 1 1. A process for treating organosilicate dielectric material, comprising:
  - 2 exposing the material to a halogenation reagent;
  - 3 exposing the material to an alkylation reagent; and
  - 4 exposing the material to a termination reagent.
- 1 2. The process of claim 1 wherein the halogenation reagent is selected from the group consisting of  $\text{SOCl}_2$ ,  $\text{SOBr}_2$ ,  $\text{PCl}_3$ ,  $\text{PBr}_3$ ,  $\text{PCl}_5$ ,  $\text{PBr}_5$ ,  $\text{POCl}_3$ ,  $\text{Cl}_3$ , and  $\text{Br}_2$ .
- 1 3. The process of claim 1 wherein the alkylation reagent is selected from the group consisting of ethylene, propylene, 1-butylene, and Grignard reagents.
- 1 4. The process of claim 1 wherein the termination reagent is selected from the group consisting of trimethylchlorosilane, hexamethyldisilazane, and alkyl halides.
- 1 5. The process of claim 1 wherein the process occurs *in situ* with a process that breaks at least one silicon-carbon bond in the dielectric material.
- 1 6. The process of claim 1 further comprising using an energy generator to increase the reaction rate of the process.

1 7. A process for fabricating an insulating layer on an integrated circuit structure comprising:  
2 forming a layer of organosilicate insulating dielectric material on the integrated circuit  
3 structure;  
4 forming a resist mask on the layer of dielectric material;  
5 etching the layer of dielectric material using the mask;  
6 removing the resist mask;  
7 exposing the dielectric material to a halogenation reagent;  
8 exposing the dielectric material to an alkylation reagent; and  
9 exposing the dielectric material to a termination reagent.

1 8. The process of claim 7 wherein the halogenation reagent is selected from the group  
2 consisting of  $\text{SOCl}_2$ ,  $\text{SOBr}_2$ ,  $\text{PCl}_3$ ,  $\text{PBr}_3$ ,  $\text{PCl}_5$ ,  $\text{PBr}_5$ ,  $\text{POCl}_3$ ,  $\text{Cl}_3$ , and  $\text{Br}_2$ .

1 9. The process of claim 7 wherein the alkylation reagent is selected from the group  
2 consisting of ethylene, propylene, 1-butylene, and Grignard reagents.

1 10. The process of claim 7 wherein the termination reagent is selected from the group  
2 consisting of trimethylchlorosilane, hexamethyldisilazane, and alkyl halides.

1 11. The process of claim 7 wherein the removal of the photoresist mask and the exposure to  
2 the reagents are performed in a common chamber.

1 12. The process of claim 11 further comprising using an energy generator in the chamber to  
2 increase the reaction rate of the process.

1 13. A semiconductor device, comprising a methylsilsesquioxane dielectric where at least one  
2 of the methyl groups has been replaced by end groups of the form  $R_1OR_2$ , wherein  $R_1$  is selected  
3 from the group consisting of  $C_1-C_5$  lower alkyls and  $R_2$  is selected from the group consisting of  
4 trimethylsilyl and  $C_1-C_5$  lower alkyls.

1 14. A process for treating damaged low-k organosilicate dielectric material whose dielectric  
2 properties have been degraded by a previous processing step, comprising:  
3 exposing the material to a halogenation reagent;  
4 exposing the material to an alkylation reagent; and  
5 exposing the material to a termination reagent.